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RESEARCH PAPER

Life Satisfaction and Keeping Up with Other Countries

Ozan Eksi[1] · **Neslihan Kaya**[2]

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Abstract Micro income studies show that relative income of individuals—with respect to their colleagues, friends, etc.—affects their life satisfaction significantly. This paper attempts to extend these studies by using the idea that people may compare their well-being not only to well-being of their home country folks but also to well-being of other country citizens. Using data from national surveys of 55 countries, carried out from 1973 to 2011, we find that average life satisfaction of a country is significantly affected from how much that country is deprived of income compared to richer countries in the world. Furthermore, per capita income of a country only matters as far as it affects its relative position in the global income distribution. This result, gaining statistical significance after 1990s, is a potential explanation for the paradox that even though richer countries tend to be happier compared to poor ones, a country does not necessarily get happier as its income increases.

Keywords Life satisfaction · Relative deprivation · Global comparison groups

JEL Classification I31 · O57 · Z13

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✉ Ozan Eksi
ozaneksi@gmail.com; oeksi@etu.edu.tr;
http://ozaneksi.weebly.com

Neslihan Kaya
neslihan.kaya@tcmb.gov.tr

[1] Department of Economics, TOBB University of Economics and Technology, Sogutozu Street, No: 43, 06560 Ankara, Turkey

[2] Research and Monetary Policy Department, Central Bank of the Republic of Turkey, 06560 Ankara, Turkey

Do not spoil what you have by desiring what you have not remember that what you now have was once among the things you only hoped for.
–Epicurus (341–270 BC)

1 Introduction

The empirical patterns of the relationship between income and subjective well-being (happiness or life satisfaction) are already well-known: (1) rich individuals tend to have higher subjective well-being compared to poor ones (see e.g. Easterlin 1974; Stevenson and Wolfers 2008), (2) the richer the individuals get, the happier they become (see e.g. Ferrer-i-Carbonell 2005; Gardner and Oswald 2007), (3) the countries with higher per capita income are more satisfied with their lives compared to lower per capita income countries,[1] (4) the long term relationship between per capita income and average life satisfaction within a country is ambiguous.[2,3]

A well-known seemingly contradictory pattern suggested by these empirical findings is that even though there is a positive correlation between individuals' incomes and their subjective well-being; such a correlation is not so obvious at the country level; that is, even though countries experience long term growth rates, the average well-being of their citizens stays more or less the same. This paradox is first pointed out by Easterlin (1974). One of the explanations to Easterlin paradox is the relative deprivation hypothesis. This hypothesis is based on the idea that human beings routinely compare themselves to others. An increase in an individual's income may increase his subjective well-being, probably as it creates a feeling of success or doing better than his/her comparison group, but within a country as everyone cannot do better than the rest of the citizens, the average life satisfaction in the country is independent of its GDP (Gross Domestic Product). Another explanation to the Easterlin paradox is the rising aspirations theory, asserting that increases in people's income may increase their subjective well-being in the short term; however, in the long term people adapt to increases in their incomes and only opt for more, and that is why increases in per capita GDP do not increase the average well-being of the citizens.[4]

At this point, the question that remains to be answered is as follows: "There are several explanations for the weak correlation between per capita income of a country and its average life satisfaction in the time series data but then how do we explain the strong correlation between these variables in the cross country data? In other words, why do richer countries tend to be happier compared to poor ones while a country does not necessarily get happier as its income increases?" Certainly, the relative deprivation with local comparison groups and rising aspirations theories cannot answer this question.

[1] Even though Easterlin (1974) study, based on 14 countries, discusses that countries with higher per capita income are not necessarily happier than lower per capita income countries, recent studies such as Stevenson and Wolfers (2008) and Deaton (2008) find that the relationship between life satisfaction of a country and logarithm of per capita income is almost linear, which is in line with our findings.

[2] Studies such as Veenhoven and Hagerty (2006) and Stevenson and Wolfers (2008) discuss that an increase in income is accompanied with higher happiness, especially in poor countries, whereas studies such as Easterlin (1974), Easterlin (2005), Easterlin and Sawangfa (2010) discuss the opposite.

[3] Readers may refer to Clark et al. (2008) for a thorough survey of the literature on the relation of income and happiness.

[4] See e.g. Frey and Stutzer (2002), Stutzer (2004). In general, this is the hedonic treadmill, also known as hedonic adaptation (Brickman and Campbell 1971), which is the tendency of humans to quickly return to a relatively stable level of happiness despite major positive or negative events or changes in life conditions.

Another theory that attempts to solve the Easterlin Paradox is the threshold theory, which discusses that as far as the richer countries are concerned, richer ones are not necessarily happier than the relatively poorer ones (see e.g. Inglehart 1997; Layard 2005). On the other hand, Deaton (2008) discusses that when logarithm of GDP per capita is used instead of its level, it becomes obvious that each doubling of GDP is associated with a constant increase in life satisfaction, in support of which we find evidence in this paper as well.[5]

This study offers a new explanation for the discrepancy between the evidences obtained from cross-sectional and time series data mentioned above, that is, even though richer countries tend to be happier compared to poor ones, a country does not necessarily get happier as its income increases. To that end, we extend the relative deprivation hypothesis. The existing studies suggest that people compare themselves to their national citizens.[6] This study, on the other hand, suggests that due to the integration of societies via globalization, people may compare themselves to citizens of other countries as well. In addition, such comparisons may have social and economic consequences. For instance, the movements in the Middle East and North Africa at the beginning of the 21st century may be considered as an outcome of such a comparison. This view suggests that increases in per capita income of a country may not increase its average subjective well-being if the country's location in world income distribution more or less stays the same. However, in the cross-section we would still observe that richer countries are happier than the poor ones, since rich countries feel relatively superior, or poor countries feel relatively deprived, or both.

To the best of our knowledge, there are only a few studies where international reference groups are formed in the relevant literature. Among them, Delhey and Kohler (2006) uses the data from Euromodule and German Welfare Surveys that ask the respondents to rate their living conditions in their own countries and also in some European Union reference countries.[7] Their results support the presence of international reference groups and indicate that especially citizens of relatively poor countries compare their countries with richer ones.[8] Sági (2012) discusses that before the political changes that took place in the 1990s, the citizens of some socialist countries, such as Ukraine, Poland, Hungary and Georgia, preferred to compare their standards of living to their socialist equivalents rather than to their capitalist West European counterparts. However, today, in each of the four countries, this pattern is reversed, which, according to her, is most likely the end of the economic and political integration of European societies. The new economics of labor migration also

[5] Deaton (2008), using data from both World Values Survey and the Gallup World Poll, further discusses that the remaining differences between his study and the previous studies can be explained by the fact that previous studies use World Values Survey data, which suffers from sampling issues.

[6] Within the national framework, the comparison group may be defined as all other citizens (Easterlin 1995) other citizens with similar education, age, gender and area of living (Ferrer-i-Carbonell 2005); other citizens sharing the same age group (McBride 2001); one's professional peers (Clark and Oswald 1996; Senik 2008) or one's own earlier living conditions (Goodman 1974; Senik 2009).

[7] These surveys are conducted over 1998–2002 and cover West Germany, East Germany, Hungary and Turkey.

[8] Delhey and Kohler (2006), which uses cross-sectional data, does not use richer individuals within a country as comparison groups of individuals. In this case it would be difficult to distinguish the effect of local and global comparison groups, as average income in the richer country would be a proxy for richer individuals within the country (a well-known omitted variable bias). (The authors indicate that they do not use these two comparison groups simultaneously to avoid multi-collinearity, which we believe is a reasonable argument given the data they use.) Similar to this study, we also do not control for relative deprivation within the country. However, we improve Delhey and Kohler (2006)'s results further by using time series data, which measures directly the effect of changes in the relative income of countries and controls the unobserved heterogeneity or omitted variable problem.

hypothesizes that people migrate not only to improve their income in absolute terms, but also in relative terms. Stark and Yitzhaki (1988), in particular, argues that migration propensities will be positively correlated with inequality in the origin societies, and negatively correlated with inequality in the destination societies. Czaika and De Haas (2011) further shows that international migration flows display such a complex pattern that they cannot be solely explained as a function of distance and income differentials between countries but should be explained by combinations of absolute deprivation (human development, economic well-being), internal relative deprivation (that the person feels within his country) and global relative deprivation (that the person feels by comparing its country with the richer ones).

In order to test the presence of cross-border comparison groups in the area of subjective well-being, we use panel life satisfaction data from 55 countries. For this purpose, we first define the global relative deprivation index (RDI, hereafter), which is based on a country's location in the world income distribution. This index basically measures the relative income position of a country, which compares itself to the richer part of the world.[9] We find that RDI significantly explains the average life satisfaction of countries. Furthermore, once we control for the effect of RDI, the relationship between per capita income and average life satisfaction in countries disappears both over time and at a given point in time.

We also calculate global relative gratification index—the reverse of the RDI—, where this time we would like to understand whether citizens of a country feel satisfied when they compare themselves to the poorer part of the world. We find that the gratification index cannot explain life satisfaction in countries, indicating that global income comparison does not work in the downward direction.[10] To put it more simply, the results indicate that people feel deprived and thus feel less satisfied with their lives by comparing themselves to citizens of richer countries but on the contrary their life satisfaction does not increase by comparing themselves to poorer countries.

The regressions reveal further that GDP growth rate—as it probably creates an acceleration effect—positively and significantly explains the average life satisfaction. Inflation, on the other hand, as an indicator of macro instability, has a negative and highly significant coefficient, though its magnitude is very small. The unemployment rate is also significantly and negatively correlated with the average life satisfaction in a country. We also use other control variables for robustness analysis, such as openness indicators, democratization indicator, Gini index and share of health expenditures in GDP. Among them, only democratization indicator and share of health expenditures in GDP turn out to have a significant effect on the average life satisfaction of our sample countries.

The rest of the paper is organized as follows: Sect. 2 explains the empirical approach. Section 3 explains the data and provides some descriptive statistics. Section 4 presents and discusses the regression results. Section 5 concludes.

2 Empirical Approach

We use a typical regression model that explains the life satisfaction of countries by means of macroeconomic indicators, and augment it with a relative deprivation measure. Specifically, we estimate the following model:

[9] The calculation of the RDI is explained in the next (Empirical Approach) section.

[10] See Ferrer-i-Carbonell (2005), which finds in the micro income data that individuals compare themselves only to those who are richer.

$$\text{LifeSat}_{i,t} = \beta_0 \ln(\text{gdp}_{i,t}) + \beta_1 \text{gdp\_gr}_{i,t} + \beta_2 \text{unemp}_{i,t} + \beta_3 \underset{i,t}{\text{inf}} + \beta_4 \text{RDI}_{i,t} + c_i + \mu_t + e_{i,t}, \quad (1)$$

Subscript i, t refers to country i at time t. *LifeSat* is the average life satisfaction, ln(gdp) is the natural logarithm of per capita real GDP measured in terms of 2000 U.S. dollars, *gdp_gr* is the growth rate of real GDP per capita,[11,12] *unemp* and *inf* are the unemployment and inflation rates, respectively.

The variable RDI needs particular interest. It refers to the relative deprivation measure of country i at time t when it compares itself to richer countries. We expect that, the higher this term the less satisfied country i is with its own income. In the micro data studies, the corresponding index is a famous one, which, for an individual, is computed as a fraction of the richer individuals in the total population, multiplied by their mean excess income. In other words: *"…the social evaluation of the deprivation inherent in a person's not having X is an increasing function of the proportion of those who do have it…"* (Yitzhaki 1979).[13] We, on the other hand, need to employ global relative deprivation of country i, which is defined by the new economics of labor migration literature, as the share of world population living in countries with a higher per capita income, multiplied by the population weighted mean excess income of this richer portion of world population. Thus, micro and macro-level indices are equivalent to each other in the sense that in the latter, countries are weighted with their population figures. To be more specific, our measure is defined as follows: Suppose there are N countries with GDP per capita figures that satisfy: $GDP_{1,t} < GDP_{2,t} < \cdots < GDP_{N,t}$. Then, the relative deprivation of a country i is defined as:

$$RDI_{i,t} = \frac{\sum_{k=i+1}^{N} POP_{k,t}}{\sum_{l=1}^{N} POP_{l,t}} \frac{\sum_{k=i+1}^{N} POP_{k,t}(GDP_{k,t} - GDP_{i,t})}{\sum_{k=i+1}^{N} POP_{k,t}} \quad \text{for } i = 1, \ldots, N-1;$$
$$\text{and} \quad \text{RDI}_{N,t} = 0.$$

Finally, in addition to RDI we calculate global relative gratification index—the reverse of RDI—, measured as the share of world population living in countries with a lower per capita income, multiplied by the population weighted mean shortage of income of this poorer part of world population. This index allows us to test if the average life satisfaction of a country is affected from how much the country feels satisfied with its income compared to poorer part of the world; that is, if the global comparison works in a downward direction as well.

[11] We prefer to use natural logarithm of GDP per capita rather than its level. This is because of the assumption of diminishing marginal utility of income. However, in the relatively short time series data that we use, the increase in gdp per capita is limited; hence, the correlation between the level of the variable and its natural logarithm, as we show it, is already close to 1. This issue is more important in the cross-sectional data where the income level of countries may differ from each other a lot.

[12] Part of Eq. (1) can be written as

$$\begin{aligned}\beta_0 \ln(\text{gdp}_{i,t}) + \beta_1 \text{gdp\_gr}_{i,t} &= \beta_0 \ln(\text{gdp}_{i,t}) + \beta_1 [\ln(\text{gdp}_{i,t}) - \ln(\text{gdp}_{i,t-1})] \\ &= (\beta_0 + \beta_1) \ln(\text{gdp}_{i,t}) - \beta_1 \ln(\text{gdp}_{i,t-1}).\end{aligned}$$

Hence, using growth rate of income together with its natural logarithm is equivalent to using its current and lagged income in the same regression. We prefer the model specification in (1) as it allows to interpret the effects of both the level of income and the short term changes in income on the average life satisfaction. Finally, the average absolute correlation between gdp_gr and ln(gdp) is 0.29 in the data.

[13] This index has its roots in Runciman (1966), it is quantified by Yitzhaki (1979), and its axiomatic foundation is given by Ebert and Moyes (2000) and Bossert and D'Ambrosio (2006).

As for the empirical methodology, we use both fixed effect panel regression analysis with year and country dummies and dynamic panel estimation with Arellano-Bond's GMM estimator.[14]

3 Data and Descriptive Statistics

Life satisfaction data are obtained from the World Database of Happiness, which collects data from various surveys, defined in the first two columns of Table 1. The numerical scales of surveys are different from each other; however, the database converts them to a common 0–10 scale, 0 standing for the least satisfied and 10 for the most satisfied. It is an unbalanced dataset that spans 1971–2011 time period for 61 countries. The third and fourth columns of Table 1 show the sample period of each country and the corresponding average life satisfaction. The regressions use all the countries on the table unless the data come from World Values Survey. This survey is carried out in waves, thus it is not appropriate to use it for time series analysis but only for descriptive statistics or for cross-sectional analysis. Eventually, we use 55 countries for the time series regression analysis. A detailed description of the rest of the explanatory variables is given in "Appendix". In order to avoid biased results in our regressions, we also test for the stationarity of the life satisfaction data by using panel-specific unit root tests that work with unbalanced panels. These tests are based on Fisher (1932) and proposed by Maddala and Wu (1999) and Choi (2001). According to the test results, the null hypothesis of unit root in the life satisfaction series is rejected at 1 % significance level.

We provide descriptive statistics for the relationship between average life satisfaction and the logarithm of real GDP per capita across countries. Figure 1 displays this relationship for 1981, 1991, 2001 and 2011. In order to ensure cross country comparison, GDP figures are PPP (Purchasing Power Parity) adjusted. Observations are fitted with OLS (Ordinary Least Squares) and locally weighted scatter plot smoothing regressions. All sub-figures indicate that the richer countries tend to be more satisfied with their lives on average. There are only a few countries that are poor but happy, an observation which may be explained by folklore theory stating that happiness may be part of the national character (see e.g. Ostroot and Snyder 1985; Veenhoven 1994). The sub-figures also show that the relationship between per capita income and average life satisfaction becomes more and more obvious from 1981 to 2011 throughout the world, which is a potential explanation of the discrepancy between the findings of Stevenson and Wolfers (2008), Deaton (2008) and the Easterlin (1974) study. In 2011, the relationship between average life satisfaction and logarithm of GDP per capita in the cross section is close to linear; i.e. percent increases in per capita income across countries are correlated with constant absolute increases in the life satisfaction, consistent with the log-utility of income. Figure 2, on the other hand, explores the same relationship throughout time. The horizontal axis uses GDP per capita and the vertical axis uses average life satisfaction. For each variable, initially, the difference between the last and the first available observations for each country are taken, and then annual averages of these differences are calculated.[15] The figure

[14] Micro life satisfaction data have a categorical nature, and hence, they are usually explored via ordered probit models. However, the average life satisfaction data do not share the same characteristics.

[15] To abstain from outliers, the difference between the averages of the last two and the first two available observations are used.

Table 1 Life satisfaction data and international relative deprivation index

Country	Life satisfaction data source	Sample period	Mean life satisfaction	RDI mean	ΔRDI last-first
Argentina	WVS + Latinobarometro	1981–2006	6.33	2689	1138
Australia	WVS + AUWI Survey	1981–2008	7.80	1011	222
Austria	WVS + Eurobarometer	1990–2011	6.70	847	−98
Belgium	Eurobarometer	1973–2011	6.87	856	353
Bolivia	Latinobarometro	1997–2007	5.89	8993	1664
Brazil	WVS + Latinobarometro	1990–2007	6.67	5058	1186
Bulgaria	WVS + Eurobarometer	1990–2011	3.94	7566	1000
Canada	WVS	1982–2000	7.61	792	340
Chile	WVS + Latinobarometro	1990–2007	6.66	3649	−1092
China	WVS + Gallup Poll of China	1991–2004	6.08	8563	433
Colombia	Latinobarometro	1997–2006	7.07	6782	1090
Costa Rica	LAPOP + Latinobarometro	1978–1995	8.31	4267	1203
		1997–2007	7.56	4839	−145
Croatia	WVS + Eurobarometer	1995–2011	5.90	3643	−754
Cyprus	Eurobarometer	2001–2011	6.82	2157	−24
Czech Republic	Eurobarometer	2001–2011	6.18	3274	−150
Denmark	Eurobarometer	1973–2011	8.06	359	312
Ecuador	Latinobarometro	1997–2007	6.22	8422	1428
El Salvador	Latinobarometro	1997–2007	6.85	7275	957
Estonia	Eurobarometer	1995–1999	4.88	5144	0
		2001–2011	5.68	3662	−1090
Finland	WVS + Eurobarometer	1981–2011	7.01	828	60
France	Eurobarometer	1973–2011	6.10	899	552
Germany	Eurobarometer	1990–2011	6.44	906	34
Greece	Eurobarometer	1981–2011	5.42	2171	883
Guatemala	Latinobarometro	1997–2007	7.10	8011	1370
Honduras	Latinobarometro	1997–2007	7.05	8729	1431
Hungary	WVS + Eurobarometer	1981–1999	5.79	3475	1543
		2001–2011	5.04	3794	−236
Iceland	WVS	1981–1999	7.83	258	308
India	WVS	1990–2006	6.80	9329	1904
Ireland	Eurobarometer	1973–2011	7.05	1159	−682
Israel	ISS	2003–2010	7.92	1417	−283
Italy	Eurobarometer	1973–2011	5.86	1226	607
Japan	EPA/SPB	1970–2011	5.91	15	−87
Korea Republic	WVS	1981–2005	5.82	2510	−854
Latvia	WVS + Eurobarometer	1990–1999	4.73	5575	2004
		2001–2011	5.34	4422	−1603
Lithuania	WVS + Eurobarometer	1990–1999	4.89	5196	2363
		2001–2011	5.25	4440	−2134
Luxembourg	Eurobarometer	1973–2011	7.35	54	−19
Macedonia FYR	WVS + Eurobarometer	1997–2001	4.91	7614	439

Table 1 continued

Country	Life satisfaction data source	Sample period	Mean life satisfaction	RDI mean	ΔRDI last-first
		2007–2011	5.33	8205	−257
Malta	Eurobarometer	2001–2011	6.61	2761	−16
Mexico	WVS + Latinobarometro	1981–2007	7.21	3013	1273
Netherlands	Eurobarometer	1973–2011	7.49	771	270
New Zealand	WVS	1988–1994	7.55	1891	0
Nicaragua	Latinobarometro	1997–2007	6.69	8996	1491
Norway	WVS + ESS	1981–1996	7.50	101	3
		2002–2010	7.81	1	0
Panama	Latinobarometro	2000–2007	6.78	5039	−441
Paraguay	Latinobarometro	1997–2007	5.36	8543	1817
Peru	WVS + Latinobarometro	1996–2007	6.35	7326	935
Poland	WVS + Eurobarometer	1990–2011	5.36	4302	−1489
Portugal	Eurobarometer	1985–2011	5.28	2431	351
Romania	Romanian POB	1990–2005	4.75	7286	1412
		2006–2011	4.18	7642	−129
Russian Federation	WVS + RLMS	1990–2005	4.11	7072	2093
Slovak Rep	World Values Survey + Eurobarometer	1990–1999	5.67	3321	438
		2001–2111	5.65	3261	−338
Slovenia	WVS + Eurobarometer	1990–2011	6.42	2543	101
South Africa	WVS	1981–2007	5.59	5101	3326
Spain	Eurobarometer	1985–2011	6.37	1979	238
Sweden	WVS + Eurobarometer	1981–2011	7.60	477	−19
Switzerland	WVS + ESS	1990–2010	8.11	55	22
Turkey	WVS + Eurobarometer	1990–2011	5.17	4484	−516
United Kingdom	WVS + Eurobarometer	1973–2011	6.84	674	213
United States	WVS + Gallup Poll	1981–2008	7.71	86	10
Uruguay	Latinobarometro + LAPOP	1997–2010	6.36	3175	84
Venezuela	Latinobarometro + LAPOP	1997–2011	7.36	4016	780

World Values Survey (WVS) are carried out in waves; hence, it is only used for descriptive statistics not for the time series analysis. For each country, the sample mean of life satisfaction and global relative deprivation index (RDI), and also the difference between the last and the first observations of this index during the sample period are provided. Positive (negative) sign shows that the country experienced an increase (a decrease) in the global relative deprivation index of the country

suggests that in the long run the relationship between income and life satisfaction is not as strong as it is in the cross-sectional data, which is the motivation of this study.[16,17]

[16] The correlation between long term changes in life satisfaction and GDP per capita does not get any stronger even if we restrict the analysis to post-90s.

[17] Using 13 developing countries from the World Values Survey data, Easterlin and Sawangfa (2010) finds that the long run relation between life satisfaction and GDP per capita is negative but weak.

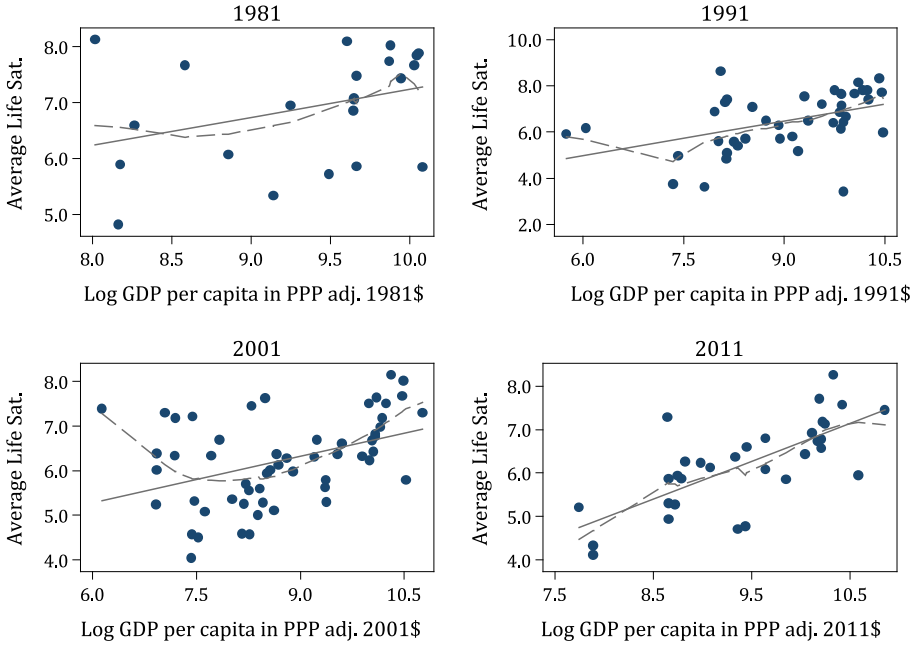

Fig. 1 Average Life Satisfaction and Log GDP per capita: Cross Country Analysis. *Notes* The *vertical axis* shows average life satisfaction of a country at a given time, and the *horizontal axis* shows logarithm of its GDP per capita. GDP figures are purchasing power parity adjusted current international dollars. *Straight lines* are fitted from an OLS regression; *dotted lines* are fitted from lowess (locally weighted scatterplot smoothing) regressions

4 Regression Analysis

4.1 Correlation Between Control Variables

In order to avoid multi-collinearity in our regressions, we check for the correlations between the control variables. We first calculate, for each country, the absolute correlations between explanatory variables. Then, we obtain a weighted average of these absolute correlations, where weights are selected to be the sample sizes of the countries. Table 2 displays the results. Given our average sample size for a country, 0.48 is the critical value at which we can reject the null hypothesis that two variables are uncorrelated at 5 % significance level. Thus in Table 2, when the correlation between any two variables is, in absolute terms, higher than 0.48, the cell at their intersection is Italicized.[18] The table shows that the correlations between control variables are most of the time less than the critical value, 0.48. On the other hand, the correlation between GDP per capita and the logarithm of this variable is very high, around 0.99, due to the relatively short time series data. Thus, the regression results are not sensitive to whether we use the level or log of the

[18] The significance of the correlation coefficient depends on the sample size. This is because a high correlation value in a short sample size could just be a statistical realization. In general, to test the significance of correlation coefficient, the following test statistics is used: $r\sqrt{(N-2)/(1-r^2)}$, where r is the correlation coefficient. This statistics follows a t-distribution with N-2 degrees of freedom.

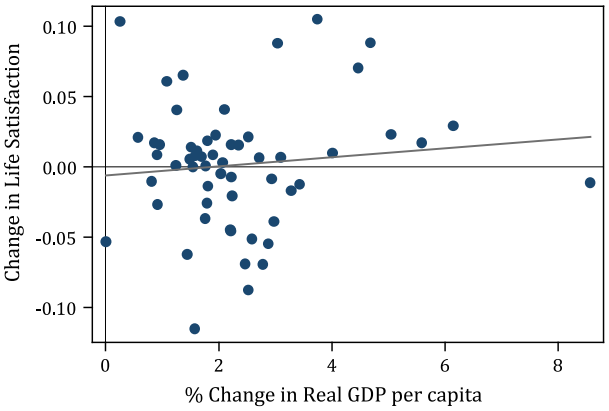

Fig. 2 Annual Changes in Life Satisfaction and in Real GDP per capita. *Notes* The *vertical axis* shows the annual average of the long term changes in average life satisfaction for a country, and the *horizontal axis* shows the annual average of the long term % changes in GDP per capita. *Straight line* is fitted from an OLS regression

Table 2 Absolute correlations between the control variables

	gdp	lngdp	gdp_gr	L.gdp_gr	unemp	inf	RDI	RGI
GDP per capita	–	*0.99*	0.29	0.30	0.45	0.34	*0.71*	*0.70*
Logarithm of GDP per capita	*0.99*	–	0.29	0.30	0.45	0.33	*0.71*	*0.72*
GDP per capita growth rate	0.29	0.29	–	0.38	0.28	0.26	0.31	0.00
Lag of GDP per capita growth rate	0.30	0.30	0.38	–	0.35	0.27	0.27	0.38
Unemployment rate	0.45	0.45	0.28	0.35	–	0.33	0.43	*0.65*
Inflation	0.34	0.33	0.26	0.27	0.33	–	0.56	*0.50*
Global relative deprivation index	*0.71*	*0.71*	0.31	0.27	0.43	*0.56*	–	*0.69*
Global relative gratification index	*0.70*	*0.72*	0.00	0.38	*0.65*	*0.50*	*0.69*	–

The absolute correlations between the variables are calculated for each country. Then the average of these correlations is calculated, by correcting for the sample size. Italicized cells are the values higher than (in absolute terms) 0.48, indicating that for those variables we cannot reject the null hypothesis that the two variables are correlated at 5 % significance level. First row on the table shows the abbreviations for the variables, which are explicitly written on the first column

income. In line with our expectations, the correlation between GDP per capita and the relative deprivation/gratification indices is also very high. This is due to the fact that RDI and RGI are functions of GDP per capita of countries. Other high correlations that should be noted are the ones between inflation and deprivation/gratification indices; and the correlation of unemployment rate with GDP per capita and the lag of growth rate of GDP per capita.

4.2 Results

Table 3 provides the effect of RDI on life satisfaction by means of fixed effect panel estimation. This table also makes robustness analysis by re-estimating for alternative sample periods. Table 4 repeats estimations in Table 3 but adds lag of dependent variable to the regressions which switches the estimation method from fixed effect to dynamic panel estimation. Below, we first summarize the estimation results for control variables, which are more or less the same in Tables 3 and 4. Note that, as Table 2 shows, some regressors in Eq. (1) are significantly correlated with each other. Hence, some columns of Tables 3

Table 3 Panel regression of country average life satisfaction

	LifeSat	LifeSat	LifeSat	LifeSat	LifeSat 1970 < year <1990	LifeSat 1980 < year <2000	LifeSat 1990 < year	LifeSat 1990 < year	LifeSat 1990 < year
Logarithm of GDP per capita	0.520 (2.04)**	−0.0532 (−0.15)	0.0463 (0.13)		−1.530 (−0.71)	0.544 (1.06)	0.435 (1.01)	0.246 (0.54)	
GDP per capita growth rate	0.00943 (2.05)**	0.0111 (2.35)**	0.00990 (1.82)*	0.0137 (2.54)**	0.0193 (1.42)	0.0108 (1.47)	0.0115 (2.14)**	0.0102 (1.73)*	0.0151 (2.50)**
L.GDP per capita growth rate	0.00843 (1.66)	0.00944 (1.71)*	0.00640 (0.91)	0.0109 (1.84)*	0.0185 (1.64)	0.00956 (1.23)	0.00852 (1.46)	0.00596 (0.80)	0.0120 (1.79)*
Inflation rate	−0.000578 (−4.35)***	−0.000742 (−5.03)***	−0.000878 (−5.24)***		−0.000355 (−0.12)	−0.000237 (−1.33)	−0.000824 (−5.51)***	−0.000889 (−4.95)***	
Unemployment rate			−0.0191 (−2.00)*					−0.0168 (−1.47)	
RDI (global relative deprivation index)		−0.000283 (−2.66)**	−0.000272 (−2.49)**	−0.000234 (−3.07)***	−0.000356 (−0.55)	−0.0000321 (−0.12)	−0.000268 (−2.40)**	−0.000254 (−2.22)**	−0.000299 (−3.71)***
Observations	953	951	860	951	187	330	750	745	750
R^2	0.112	0.131	0.167	0.120	0.163	0.123	0.135	0.198	0.170

Year and *country* fixed effects are included throughout the regressions. Robust *t*-statistics are in parentheses. *p* values are shown with stars (* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$)

GDP figures are in real terms. The global relative deprivation index is the share of world population living in countries with a higher per capita income multiplied by the population weighted mean excess income of this richer part of world population

Table 4 Panel regression of country average life satisfaction: dynamic panel estimation

	LifeSat	LifeSat	LifeSat	LifeSat	LifeSat 1970 < year <1990	LifeSat 1980 < year <2000	LifeSat 1990 < year	LifeSat 1990 < year	LifeSat 1990 < year
L.LifeSat	0.433 (4.96)***	0.426 (4.80)***	0.372 (4.29)***	0.432 (4.79)***	0.509 (4.14)***	0.198 (1.82)*	0.378 (3.96)***	0.358 (3.93)***	0.388 (3.98)***
Logarithm of GDP per capita	0.235 (1.63)	−0.144 (−0.74)	−0.0816 (−0.40)		−0.142 (−0.15)	0.467 (1.07)	0.0720 (0.29)	0.0196 (0.08)	
GDP per capita growth rate	0.0107 (3.43)***	0.0128 (3.56)***	0.0119 (2.86)***	0.0142 (3.80)***	0.00773 (0.95)	0.0125 (2.08)**	0.0136 (3.19)***	0.0121 (2.70)***	0.0157 (3.48)***
L.GDP per capita growth rate	0.00310 (0.91)	0.00423 (1.10)	0.00292 (0.62)	0.00473 (1.19)	0.00131 (0.20)	0.00437 (0.70)	0.00525 (1.22)	0.00315 (0.63)	0.00606 (1.37)
Inflation rate	−0.000276 (−2.42)**	−0.000431 (−2.16)**	−0.000593 (−3.08)***		−0.0000396 (−0.03)	−0.000104 (−1.05)	−0.000479 (−2.25)**	−0.000607 (−2.93)***	
Unemployment rate			−0.0134 (−1.84)*					−0.0130 (−1.43)	
RDI (global relative deprivation index)		−0.000209 (−2.58)**	−0.000225 (−2.68)***	−0.000147 (−2.50)**	0.0000402 (0.13)	0.0000447 (0.24)	−0.000216 (−2.41)**	−0.000214 (−2.38)**	−0.000188 (−2.47)**
Observations	876	874	794	874	161	299	700	695	700
F-stat_(p value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

The results are obtained with Arellano Bond's difference GMM estimator. Year and country fixed effects are included. Robust t-statistics are in parentheses. p values are shown with stars (* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$)

GDP figures are in real terms. The global relative deprivation index is the share of world population living in countries with a higher per capita income multiplied by the population weighted mean excess income of this richer part of world population

and 4 make also robustness checks by excluding correlated variables from regressions. This practice also shows how correlation among variables can significantly affect the results.

Logarithm of GDP per capita: The first column of Table 3 shows that this variable is significant at 5 % in explaining average life satisfaction in countries. However, the second and the third columns show that when global relative deprivation is added to the regressions, the variable loses its explanatory power and also experiences a significant decline in its coefficient. The rest of Table 3 and the dynamic panel regressions in Table 4 also find that this variable is insignificant in explaining life satisfaction. Thus, our result is straightforward: what matters for the life satisfaction of a country is the change in the country's relative position in world income distribution, measured by the global relative deprivation index. Only when this index is excluded, per capita income of the country becomes significant in explaining life satisfaction, probably because in that case the variable becomes an incorrect measure of the country's income performance.

GDP per capita growth rate: GDP growth rates are expected to be positively correlated with the life satisfaction of countries. This prediction is justified in almost all specifications through Tables 3, 4. Its coefficient, on the other hand, is low, being around 0.01–0.015; meaning that one percentage point increase (decrease) in per capita real GDP growth rate—say from 1 to 2 % per year—leads to a 0.01–0.015 point increase (decrease) in life satisfaction.[19] The fixed effect estimation in Table 3 shows that this variable tends to be significant mostly at 5 % level of significance. When we include unemployment in the regressions, this significance reduces to 10 %. However, with the dynamic panel estimation in Table 4, its significance level increases to 1 % whether or not we include the unemployment rate in the regressions. Both tables show that this variable gains significance after 1990s.

Lag of GDP per capita growth: In order to control for the effect of changes in GDP growth on life satisfaction that may last for more than one period, we use the first lag of GDP per capita growth in our estimations. However, the lag of GDP per capita growth turns out to be insignificant in most of the regressions.

Inflation rate: As an indicator for macro instability, inflation has a significant explanatory power in life satisfaction after 1990s. However, its coefficient is very small, around −0.0007, meaning that 1 % point increase in inflation leads, on average, to 0.0007 point decline in life satisfaction. This is also to say that 15 % points increase in inflation exerts the same effect on average life satisfaction with a 1 % point decline in the real GDP growth rate. This may seem at odds with some previous evidence obtained by ordered probit regressions. Within that context, Di Tella et al. (2003) and Di Tella and MacCulloch (2008), using micro data covering 1975–1992 and 1975–1997 periods, respectively, and using mainly Eurobarometer series, find comparable roles for the sizes of the effects of inflation rate and GDP per capita growth rate on life satisfaction. This may be because of the fact that their dataset only consists of developed countries which have low inflation rates, thus a 1 % point increase in inflation rate may indicate a significant deterioration in perception of economic stability.

Unemployment: The availability of the unemployment data restricts our sample size a lot for the pre-1990 period, to only 102 observations. Hence, unemployment rate is not used in every regression in Tables 3 and 4. When it is used, it is significant at 10 % over the whole sample, and insignificant after 1990s. However, this variable is highly correlated

[19] We do not discriminate for the asymmetric effect of GDP growth on average life satisfaction during expansion and contraction cycles of economies.

with log of GDP per capita, the contemporaneous value of growth rate of GDP per capita and its first lag. Even though we do not show the associated results on the tables, when we exclude these variables from the regressions, the significance of the unemployment rate increases to 5 %. Finally, 1 % point increase in unemployment rate leads to around 0.02 point decline in average life satisfaction.

Lag of Life Satisfaction: The lag of life satisfaction is expected to have high explanatory power in estimating the current level of life satisfaction. However, when the model is estimated with the lag of the dependent variable, it becomes a dynamic one, and as a result, fixed effect estimation is no longer appropriate.[20] Thus, we follow a classical method to estimate the dynamic panel data model, the so-called Arellano and Bond (1991)'s difference GMM estimator.[21] According to the results revealed in Table 4, this variable explains the current life satisfaction positively at 1 % significance level almost in every regression.

Global Relative Deprivation Index (RDI): Tables 3 and 4 show that this index consistently and significantly explains the average life satisfaction of countries. Its coefficient is negative and significant at 5 and 1 % in all regressions, excluding pre-1990s. The negative coefficient indicates that the higher the country feels deprived relative to the richer part of the world, the less satisfied its citizens are on average.[22] The results are robust to the inclusion of different control variables in the regressions, that is, they are robust whether or not we use RDI together with the variables that it is significantly or highly correlated with. To better understand the size of the effect of RDI on life satisfaction of countries, note that the coefficient of this variable is around −0.00025, and that the average relative deprivation index for our sample is around 3800 (Table 1). Hence, as far as our sample is concerned, on average, global relative deprivation index affects life satisfaction of countries in our sample by around 0.95 points, higher than the effect of any other variable in the dataset. We elaborate more on the result on RDI in Sect. 4.3, and use additional control variables to test the robustness of this index further in Sect. 4.4.

Global Relative Gratification Index (RGI): The results on the first four columns of Table 5 show that this measure does not have a significant explanatory power in explaining average life satisfaction, except in only one of the regressions where it is significant at 10 %. However, this regression excludes the inflation and logarithm of GDP per capita as control variables. Hence, our results based on the relative gratification index indicate the absence of a downward comparison among countries. In other words, citizens of a country do not feel more satisfied with their lives by comparing themselves to the citizens of poorer countries.

[20] This is because in a dynamic panel data model the unobserved panel-level effects (c_i's in Eq. (1)) are correlated with the lagged dependent variables, making standard estimators inconsistent. This problem is even amplified when errors (e_{it}) follow an autoregressive process, which creates a correlation between explanatory variable $LifeSat_{i,t-1}$ and the error term e_{it-1}. Also when T is small and when one uses fixed effect approach—which demeans the data—the mean of lagged dependent variable carries information from all observations of life satisfaction. Similarly, the mean of error terms carries information from all observations of the same variable. Hence, the demeaned lagged dependent variable and the error term become correlated.

[21] This estimator initially takes the first difference of Eq. (1), in order to remove the unobserved heterogeneity that is c_i's. If there is still correlation between differenced lagged dependent variable and disturbance process, that is between $\Delta LifeS_{i,t-1}$ and $\Delta e_{i,t}$, this problem is overcome with GMM approach, which chooses at least second or third lags as instruments for the lagged dependent variable, so that these lags will be correlated with the lagged dependent variable but not with e_{t-1}.

[22] In calculating the global relative deprivation index, instead of finding the countries that are richer than country i for each year separately, if we assume that the list of countries that country i compares itself to does not change over time, the significance of the results increases to 1 % for every regression after 1990s.

Table 5 Panel regression of country average life satisfaction: global relative gratification and gini indices

	LifeSat	LifeSat	LifeSat Dynamic Panel Est.	LifeSat Dynamic Panel Est.	LifeSat	LifeSat	LifeSat	LifeSat 1990 < year
Logarithm of GDP per capita	0.414 (1.32)		0.154 (0.98)		−0.360 (−0.45)	1.139 (2.06)**	−0.510 (−0.64)	−0.512 (−0.66)
GDP per capita growth rate	0.0162 (2.37)**	0.0175 (2.54)**	0.0136 (3.20)***	0.0146 (3.52)***	0.0246 (1.61)	0.0240 (1.55)	0.0261 (1.72)*	0.0263 (1.76)*
RGI (Global relative gratification index)	0.00000303 (0.54)	0.00000771 (1.68)*	0.00000211 (0.66)	0.00000391 (1.35)				
RDI (Global relative deprivation index)					−0.000611 (−2.08)**		−0.000710 (−2.63)**	−0.000711 (−2.70)**
RDI * Gini Index (demeaned)							−0.00000937 (−1.55)	−0.00000939 (−1.59)
Gini index						−0.00483 (−0.31)	−0.0228 (−1.47)	−0.0229 (−1.51)
Observations	953	953	876	876	386	386	386	367
F-stat_(p value)			0.000	0.000				
R^2	0.153	0.153			0.485	0.494	0.411	0.408

Year and country fixed effects are included throughout the regressions. Robust t-statistics are in parentheses. p values are shown with stars (* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$)

GDP figures are in real terms. The global relative gratification (deprivation) index is the share of world population living in countries with a lower (higher) per capita income multiplied by the population weighted mean shortage (excess) income of this poorer (richer) part of world population

4.3 Further Analysis of the Effects of Global Relative Deprivation on Average Life Satisfaction

Table 1 provides descriptive statistics for the RDI. The 'RDI Mean' column displays the sample mean for each country. As we stated previously, the average relative deprivation index for the whole sample is around 3800. Remember that the regression results on Tables 3 and 4 indicate that the coefficient of this variable—the effect of a unit increase in RDI on life satisfaction—is around −0.00025. According to this table, for instance if 1 day Australia, which has sample mean of RDI around 1000, feels the same global relative deprivation index with Norway, which has sample mean of 1, then it would experience a 0.25 point increase in its average life satisfaction. Having said that, Norway seems to be the country suffering least from global relative deprivation in our sample, followed by Japan and Luxemburg.[23] The countries suffering most from the global relative deprivation in our sample are India, Nicaragua and Honduras.

Table 1 also provides a column named 'ΔRDI, Last-First', which shows the difference between the last and the first observation for the RDI during the sample period. A positive (negative) value shows that the country experienced an increase (a decrease) in its global relative deprivation index during the sample period, that is the country feels more (less) deprived by comparing itself to its richer counterparts. According to this column, emerging market economies, such as Chile, Hungary, Latvia, Lithuania, Poland, Turkey feel less deprived at the end of their sample periods; hence, given the average effect of global relative deprivation on average life satisfaction, we would expect these countries to experience increases in their average life satisfaction. Some of the other emerging markets, such as Argentina, Brazil, Bulgaria, China, Colombia, India, Mexico, Peru, Russia, South Africa and Venezuela, have experienced increases in their global relative deprivation indices. Some developed countries—classified such according to IMF (International Monetary Fund)—experienced decreases in their global relative deprivation indices over their sample period (Austria, Czech Republic, Estonia, Ireland, Israel, Japan, Latvia, Slovakia, South Korea), while some others experienced increases (Australia, Belgium, Canada, Denmark, Estonia, Finland, France, Greece, Iceland, Italy, Netherlands, Portugal, Slovenia, Spain, United Kingdom). Many countries, such as Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Slovakia and Slovenia, which joined the European Union in 2004 managed to reverse the pre-2000 increasing trend in their global relative deprivation indices.[24] In other words, these countries feel less deprived after joining the European Union.

The last column of Table 1 shows that for 43 out of 61 cases, countries experienced increases in their relative deprivation indices; only for 17 cases the reverse is valid. The average change in the index across countries is 456, its direction being upwards. It is interesting to see that even China, having experienced high GDP per capita growth rates, saw an increase of 433 points in its global relative deprivation index during the 1991–2004 period. The reason is as follows. Even though China has remarkable growth rates, since its initial per capita GDP level is low, in absolute terms, the income gap between this country and the richer countries does not close but widen over the sample period. And even though we are not exploiting every aspect of life satisfaction, note that in line with its increased

[23] There are richer countries than Norway in the world in the same era, such as Monaco, Liechtenstein, Bermuda, and Channel Islands, but they are not included in our sample.

[24] Even though it is not seen in Table 1, Poland and Slovenia also have an increasing trend in their relative deprivation indices in pre-2000, and a decreasing trend in this index in post-2000.

deprivation, there has been a decline in the average life satisfaction of China during this period (see Brockmann et al. (2009), for complementary explanations for this decline).

We carry out a final exercise and ask *"what would be the relationship between per capita GDP and average life satisfaction in cross country data if we had removed the effect of global relative deprivation (RDI)?"*. The answer to this question can be seen in Fig. 3. This figure is analogous to Fig. 1 and shows the relationship between per capita GDP and average life satisfaction in 1981, 1991, 2001 and 2011; however, instead of using life satisfaction on the left axis, it uses "counterfactual average life satisfaction", calculated as follows:

$$Counter\_Lifesat_{i,t} = Lifesat_{i,t} + RDI_{i,t} * 0.00025.$$

In this formula, life satisfaction of a country at a given time is corrected with the global relative deprivation experienced by that country at that time. Some of the sub-figures in Fig. 3 indicate that the relationship between per capita GDP and counterfactual life satisfaction is slightly positive; some indicate a slightly negative relationship, or no relationship at all. On average, the sub-figures in Fig. 3 point to the fact that there is not a clear-cut relationship between per capita GDP and counterfactual life satisfaction, even when we compare the richest and poorest countries.

Next, Fig. 4 explores the correlation between long term changes in life satisfaction and RDI. This figure is analogous to Fig. 2 but uses RDI instead of GDP per capita. It shows that there is a clear negative relationship between the changes in life satisfaction and RDI in the time series data, which we did not observe between life satisfaction and GDP per capita.

4.4 Robustness Analysis

Notice that we measure the global relative deprivation of countries by using the income gaps between average citizens of the countries. At this point, one may simply ask whether there is a difference in the appropriateness of aggregation for countries with large income disparities versus countries where individual income is more homogeneous?[25] To address this issue we interact Gini index, the most commonly used measure of income dispersion within a country, with the global relative deprivation term. To that end we use the following model:

$$\begin{aligned} \text{LifeSat}_{i,t} = {} & \beta_0 \ln(\text{gdp}_{i,t}) + \beta_1 \text{gdp\_gr}_{i,t} + \beta_2 \text{RDI}_{i,t} + \beta_3 \text{Gini}_{i,t} + \beta_4 (\text{RDI}_{i,t} * \text{Gini}_{i,t}) + c_i \\ & + \mu_t + e_{i,t}, \end{aligned} \tag{2}$$

In this regression, the coefficient of RDI index is $\beta_2 + \beta_4 \text{Gini}_{i,t}$ and the coefficient of Gini index is $\beta_3 + \beta_4 \text{RDI}_{i,t}$. Hence, the effect of RDI index (Gini index) on average life satisfaction changes for different values of Gini Index (RDI index). While calculating the interaction variable in (2), we demean RDI and Gini indices to prevent multi-collinearity between the interaction variable and these variables. The results are provided on the last three columns of Table 5. The availability of Gini index limits our sample by more than a half; hence, as seen on Table 5, the estimations using Gini index use shorter sample size, around 380 observations for 33 countries. Before running the regression in (2), we first use RDI and Gini index separately as explanatory variables, on columns 5 and 6 of Table 5.

[25] We thank anonymous referee for bringing this issue to our attention.

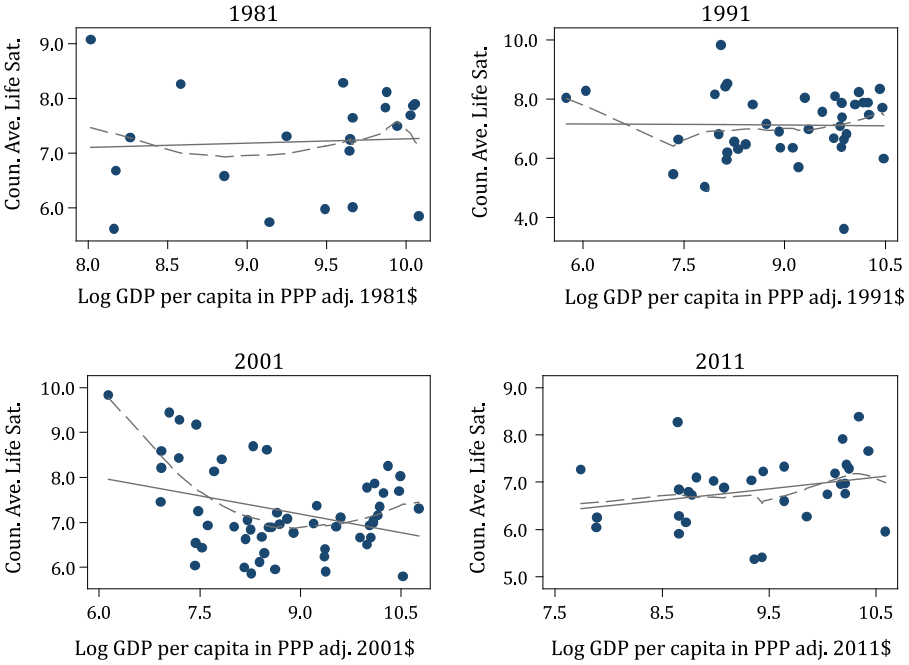

Fig. 3 Average Life Satisfaction and Log GDP per capita: Counterfactual Cross Country Analysis. *Notes* The *vertical axis* shows counterfactual average life satisfaction of a country at a given time; that is, 'what would be the relationship between per capita GDP and average life satisfaction in the cross country data once we remove the effect of global relative deprivation (RDI)'. Counterfactual average life satisfaction for a country at a given time is found according to the formula: where 0.00025 is the estimated effect of global relative deprivation on average life satisfaction. The *horizontal axis* shows log of GDP per capita of the corresponding country. GDP figures are based on purchasing power parity adjusted current international dollars. *Straight lines* are fitted from an OLS regression; *dotted lines* are fitted from lowess (locally weighted scatterplot smoothing) regressions

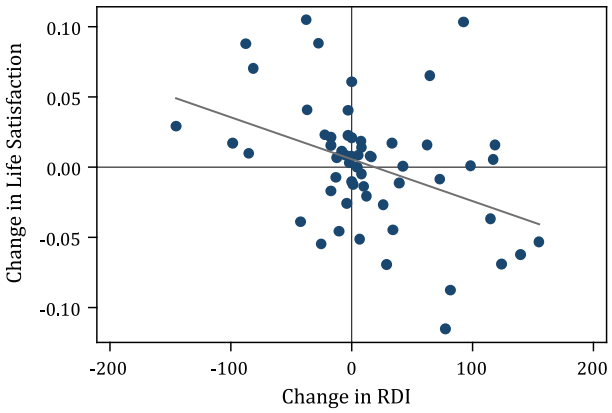

Fig. 4 Annual Changes in Life Satisfaction and in RDI. *Notes* The *vertical axis* shows the annual average of the long term changes in average life satisfaction of a country and the *horizontal axis* shows the annual average of the long term changes in its global relative deprivation index. *Straight line* is fitted from an OLS regression

The results show that RDI still significantly and negatively explains the average life satisfaction of a country, whereas Gini index does not. Finally, the last two columns of Table 5 show that neither the Gini index nor the interaction variable can explain the

average life satisfaction of a country, and that these results still hold when we restrict our sample to post-1990s. With regard to the literature on the effect of Gini index on life satisfaction, it is inconclusive. Rözer and Kraaykamp (2013), Macunovich (2011) find positive and significant effect of Gini index on life satisfaction, Winkelmann and Winkelmann (2010), Alesina et al. (2004) find negative and significant effect, and finally Graham and Felton (2006), Bjørnskov et al. (2007) find no significant effect.

The previous sections discuss that the effect of RDI on life satisfaction becomes significant after 1990s. Notice that this corresponds to a period of upward trending globalization indicators throughout the world. Hence, our next robustness analysis tests (1) whether the results for global relative deprivation remain valid after controlling for the openness of the countries (2) whether the feeling of global relative deprivation increases with the openness of countries. To this end, we use several openness indicators as control variables and also the interaction of these variables with the relative deprivation index. As openness indicators, we first use the KOF globalization index and its three-sub dimensions to capture different aspects of openness. The first of these sub-indices is the economic dimension of the globalization index capturing both actual economic flows and also economic restrictions. The second one is the social dimension of the globalization index capturing personal contact frequency, information flows (through media and internet), and cultural proximity. And the last dimension of the globalization index is the political globalization, which captures aspects such as membership in international organizations, participation in international treaties. Other than these globalization indices we use two direct indicators of a country's openness: (1) International Outbound Tourists, which is the number of people travelling abroad (2) International Inbound Tourists, which is the number of tourists visiting a country. These variables are used as indicators of the degree of interaction between citizens of different countries, which give them an opportunity to observe life in other countries and hence may trigger their global relative deprivation feeling. (Detailed information on these globalization indices and openness indicators is provided under the Data heading in the "Appendix" section.) Before turning to the results, we should note that the dataset at hand may be restrictive to answer the question we are interested in: what is the effect of openness on global relative deprivation of countries? More specifically, whether the deprivation felt by citizens of a reasonably closed country is similar to that felt in an open country. Our dataset is restrictive to answer these questions because for the sample period for which life satisfaction is available, we do not have a sample of countries that can be classified as closed. In other words, our sample is restricted by the availability of the life satisfaction data (seen on Table 1) and the availability of this data seems to require countries to be at least moderately open. For instance, in 2000, the mean KOF globalization index for our sample countries is around 70 (over 100), whereas for the countries that we could not include in our sample, mean KOF globalization index is only 40. Moreover, there are only 70 observations (including the time dimension of countries) out of 920 that are indexed below 50 in our sample; 10 observations indexed below 40; and none indexed below 30. Thus, it would not be misleading to say that this robustness analysis tests only the effect of further increases in openness of countries that can already be classified as fairly open ones, and such a practice would be misleading as, for instance, the effect of global relative deprivation on the course of openness of countries may be concave. The results for the robustness check on openness are on Table 6. On the table, each column uses a different openness indicator. The interaction of these indicators with the RDI is shown at the last row of the table. The results show that both GDP growth rate and RDI can still significantly explain the data. Among the five openness indicators, political globalization index is negatively associated with the average life satisfaction of

Table 6 Panel regression of country average life satisfaction: the interaction of global RD index with openness indices

	LifeSat	LifeSat	LifeSat	LifeSat	LifeSat	LifeSat
Logarithm of GDP per capita	−0.255 (−0.76)	−0.0585 (−0.18)	−0.279 (−0.86)	0.102 (0.30)	0.114 (0.23)	0.617 (1.20)
GDP per capita growth rate	0.0163 (2.61)**	0.0171 (2.58)**	0.0163 (2.63)**	0.0175 (2.26)**	0.0148 (2.02)**	0.0137 (1.95)*
Global RD index	−0.000331 (−2.85)***	−0.000281 (−2.62)**	−0.000318 (−2.97)***	−0.000209 (−1.83)*	−0.000328 (−2.55)**	−0.000267 (−2.18)**
Globalization index	−0.00186 (−0.26)					
Economic globalization index		0.00539 (1.03)				
Social globalization index			−0.000434 (−0.07)			
Political globalization index				−0.00560 (−1.86)*		
Number of people travelling abroad					1.55e−08 (1.45)	
Number of tourists visiting a country						2.63e−08 (2.47)**
RDI * Openness indices (demeaned)	0.00000376 (1.60)	0.000000639 (0.30)	0.00000348 (1.96)*	0.000000496 (0.52)	−3.22e−13 (−0.09)	−5.77e−12 (−1.31)
Observations	920	920	920	920	572	572
R^2	0.0733	0.135	0.0667	0.142	0.160	0.128

Year and country fixed effects are included throughout the regressions. Robust t-statistics are in parentheses. p values are shown with stars (* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$)

Each column uses a different globalization index. Detailed information on the globalization indices can be found in Data section of Appendix. The results for the interaction of globalization indices and openness indicators with the RDI are given at the last row

countries at 10 % significance level, whereas the number of tourists visiting a country (international inbound tourists) is positively associated with the average life satisfaction of countries at 5 % significance level. That is, there is a positive relationship between the number of tourists visiting a country and average life satisfaction. With regard to the interaction of globalization indices and RDI, among all openness indicators, only an increase in social globalization index seems to reduce the negative effect of RDI on life satisfaction, which could be interpreted as further social integration reducing the global relative deprivation feeling. This term, even though unexpected, is significant only at 10 % and its magnitude is very small (0.00000348).

We also control for the effect of a series of social and economic variables that we consider to be potentially effective on the average life satisfaction of countries, which are the sum of Public and Private Health Expenditure (% of GDP) and the Polity score. The latter one is an indicator for democratic development that ranges from +10 (strongly democratic) to −10 (strongly autocratic) and is taken from the Polity IV Project. According to the results on Table 7, the polity score has a positive sign, implying that the more democratic the country, the more satisfied their citizens are with their lives, though it is insignificant. The insignificance of this variable may be explained by the fact that the variance of polity score within a country over time is very small, and large changes in this score are generally clustered around 0 (see Giavazzi and Tabellini 2005). Hence, we follow the same approach with Giavazzi and Tabellini (2005) and recode the Polity Score in a way

Table 7 Panel regression of country average life satisfaction: alternative control variables

	LifeSat	LifeSat	LifeSat	LifeSat	LifeSat
Logarithm of GDP per capita	−0.0280 (−0.06)	−0.00613 (−0.01)	0.558 (1.08)	0.560 (1.08)	0.370 (0.74)
GDP per capita growth rate	0.0218 (2.50)**	0.0222 (2.48)**	0.0159 (2.51)**	0.0129 (1.99)*	0.0149 (2.40)**
RDI (Global relative deprivation index)	−0.000315 (−2.29)**	−0.000303 (−2.13)**	−0.000262 (−2.17)**	−0.000265 (−2.14)**	−0.000311 (−2.60)**
Polity score	0.0190 (1.07)				
Polity score dummy		0.206 (3.45)***			
Health expenditure (% of GDP)			0.0677 (1.95)*		
Public health expenditure (% of GDP)				0.0201 (0.45)	
Private health expenditure (% of GDP)					0.127 (2.67)***
Observations	828	828	686	686	686
R^2	0.172	0.173	0.187	0.184	0.195

Year and country fixed effects are included throughout the regressions. Robust t-statistics are in parentheses. p values are shown with stars (* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$)

GDP figures are in real terms. The global relative deprivation index is the share of world population living in countries with a higher per capita income multiplied by the population weighted mean excess income of this richer part of world population. The polity score is an indicator for democratic development that ranges from +10 (strongly democratic) to −10 (strongly autocratic). The Polity Score dummy is equal to 1 when this index is positive and 0 when the index is less than or equal to 0

that it is equal to 1 when it is positive and 0 when it is less than or equal to 0, so that the index divides the countries as stable and non-stable countries and captures the effect of democratization. When we do that we find the effect of democratization on average life satisfaction of countries to be positive and significant at 1 %, which is in line with Owen et al. (2008) that uses the same decoding for polity index. Finally, the sum of public and private health expenditure (% of GDP) explains life satisfaction at 10 % significance level. Its sign is positive, meaning that the higher the expenditure on health the more satisfied the representative citizens are. Moreover, we divide this variable into its components and use them in the regressions separately. We find that while the share of public health expenditure in GDP cannot explain the average life satisfaction in countries, the share of private health expenditure explains it at 1 % significance level. The literature discusses that (1) there is a bidirectional relationship between health and average life satisfaction (health satisfaction is an important component of average life satisfaction (Deaton 2008) and subjective well-being may improve not only physical and mental health but also may prevent becoming ill (Veenhoven 2007)), and (2) one can increase the components of health expenditures even further (such as expenditures related to primary vs. special health care); hence, we do not attempt to exploit the relation between health expenditures and life satisfaction any further. What is more crucial from other point of view is that the effect of RDI on average life satisfaction in countries is robust to the inclusion of these control variables.

4.5 Alternative Comparison Groups and Alternative Measures of Deprivation

RDI index, as a relative deprivation measure, is a complex one using a large sample of observations and measuring both cardinal (the difference between a country's own income and the income of the reference group) and ordinal (the share of world population living in richer countries, which also gives the ranking of the country in the world income distribution) aspects of deprivation. On the other hand, in the micro income studies that measure the deprivation of an individual with respect to a certain group of people, we see common usage of more simple measures for deprivation, for instance, average income of th comparison groups. To understand whether the relative deprivation concept, inherited in RDI index, will be reflected with more simple measures or not, we conduct an alternative measure of deprivation: the average per capita GDP of the comparison group countries. In addition, to understand whether countries take short-term relative performances of other countries into account, we also use the average per capita GDP growth rate of comparison countries. As for the alternative comparison groups, one can think of groups based on social, economic, political classes and so on. Once again turning to the micro studies, we see that people routinely compare themselves to their social surroundings, such as colleagues, neighbors, mates, etc. Thus, we take a similar step and in addition to "all richer countries in the world", which is our main comparison group used for the RDI, we also consider "neighboring countries" and "only richer neighboring countries" as alternative comparison groups. To that end, the alternative comparison group of countries and alternative relative deprivation measures we use are as follows:

1. All neighboring countries
    i. Average (log) real GDP per capita of these countries.
    ii. Average per capita GDP growth rate of these countries.
2. Only richer neighboring countries

i. Average (log) real GDP per capita of these countries.
ii. Average per capita GDP growth rate of these countries.

3. All richer countries in the world

i. Average (log) real GDP per capita of these countries.
ii. Average per capita GDP growth rate of these countries.[26]

Table 8 shows the correlation between these relative deprivation measures. Although we do not use these measures in the same regression, this table is informative as it displays the similarity of alternative deprivation measures. According to Table 8, the average GDP per capita of all comparison groups is significantly correlated with each other and with country's own GDP per capita. These results simply indicate the similarity in the long term growth rates of countries. On the other hand, the correlations between different types of relative deprivation measures are low except the correlation of the relative deprivation and gratification indices with GDP per capita based deprivation measures. This is due to the fact that these measures are included in the calculation of RDI.

Table 9 shows the regression results. It shows that all of the above-listed alternative deprivation measures for alternative reference groups are insignificant, except the two of them. The first one is richer countries' GDP per capita, in column 1. The coefficient of this variable is significant and positive. Even though we consider this variable to capture the income of the reference group and, as a result, expect a positive sign for its coefficient, notice that country's own GDP per capita is no longer significant once we use this variable. Hence, it may account for the dynamics of life satisfaction related to country's own GDP per capita as the correlation between this variable and country's own GDP per capita is 0.87. Nonetheless, column (2) of Table 9 shows that, once we control for RDI, this variable loses its significance. The other significant variable on Table 9 is the richer neighboring countries' GDP per capita growth rate (on column 5). Yet, again, once we control for RDI (on column 6), this variable loses its significance as well.

4.6 Discussion of the Results

Our study is motivated by the fact that the average life satisfaction of a country does not necessarily increase with an increase in its GDP per capita, even though richer countries are observed to be more satisfied with their lives compared to their poorer counterparts. Our paper explains this discrepancy by indicating that it is not the absolute income of countries but rather their relative income that primarily determines their well-being. As all countries display more or less stable growth patterns, their ranking in the world income distribution hardly even changes over time. Hence, we observe a weak relation between increases in per capita income and average life satisfaction throughout time. The cross-sectional data, on the other hand, is directly informative for the relative incomes; hence, we are able to observe that richer countries are more satisfied with their lives compared to poor countries.

Our results have several other direct practical implications. Firstly, in the previous literature briefly discussed in the Introduction, the effect of changes in GDP per capita on life satisfaction was, if not ambiguous, controversial. Our study, by using a well-founded measure of deprivation, shows that it is not absolute but relative income of countries that primarily determines their well-being. It also offers a novel approach to gauge how much

[26] The estimation results do not change when we use the population weighted versions of these measures.

Table 8 Absolute correlations between the relative deprivation measures

	lngdp	n_gdp	r_gdp	rn_gdp	n_gdp_gr	r_gdp_gr	rn_gdp_gr	RDI	RGI
Logarithm of GDP per capita	–	*0.87*	*0.86*	*0.83*	0.28	0.25	0.34	*0.71*	*0.72*
Neighbor's (log) GDP per capita	*0.87*	–	*0.82*	*0.93*	0.27	0.24	0.32	*0.68*	*0.78*
Richer countries' (log) GDP per capita	*0.86*	*0.82*	–	*0.81*	0.31	0.27	0.32	*0.72*	*0.84*
Richer neighbor's (log) GDP per capita	*0.83*	*0.93*	*0.81*	–	0.29	0.29	0.30	*0.70*	*0.74*
Neighbor's GDP per capita growth rate	0.28	0.27	0.31	0.29	–	*0.73*	*0.90*	0.31	0.25
Richer Countries' GDP per capita growth rate	0.25	0.24	0.27	0.29	*0.73*	–	*0.74*	0.27	0.23
Richer Neighbor's GDP per capita growth rate	0.34	0.32	0.32	0.30	*0.90*	*0.74*	–	0.39	0.30
Global relative deprivation index	*0.71*	*0.68*	*0.72*	*0.70*	0.31	0.27	0.39	–	*0.69*
Global relative gratification index	*0.72*	*0.78*	*0.84*	*0.74*	0.25	0.23	0.30	*0.69*	–

The absolute correlations between the variables are calculated for each country. Then the average of these correlations is calculated, by correcting for the sample size. Italicized cells are the values higher than (in absolute terms) 0.48, indicating that for those variables we cannot reject the null hypothesis that the two variables are correlated at 5 % significance level. First row on the table shows the abbreviations for the variables, which are explicitly written on the first column

the position of countries in world income distribution affects the subjective-well-being of their citizens. It provides descriptive statistics for both the mean value and the changes in relative deprivation index during the sample period for each country; hence, one can calculate the effect of changes in RDI index on life satisfaction for all countries included in the sample.

Secondly, our results have implications for the discussion about whether a country should concentrate on growth policies based on competition with the outside world or on the policies improving social equality among its citizens. Even though possibly no one can deny the importance of social equality, our results imply that it would be hard for a country to sustain a long-term subjective well-being of its individuals by only concentrating policies on improving income distribution within the country and ignoring what happens in the outside world.

Thirdly, our results are indicative of the existence of global comparison groups. Such a result may have a wide range of economic and social consequences. For instance, several studies discuss that feeling relatively deprived compared to the others influences the behavior of individuals in several ways, such as exerting more effort, migrating, acquiring better skills and sabotaging the performance of others (Zizzo and Oswald 2001; Rizzo and Zeckhauser 2003; Stark and Hyll 2011). A similar perspective could be validated for

Table 9 Panel regression of country average life satisfaction: alternative comparison groups and deprivation measures

	LifeSat	LifeSat	LifeSat	LifeSat	LifeSat	LifeSat	LifeSat	LifeSat
Logarithm of GDP per capita	0.410 (1.65)	−0.159 (−0.45)	0.530 (1.98)*	0.538 (1.36)	0.744 (1.92)*	0.105 (0.20)	0.644 (1.91)*	0.562 (2.15)**
GDP per capita growth rate	0.0146 (2.64)**	0.0162 (2.75)***	0.0158 (2.83)***	0.0166 (2.61)**	0.0191 (2.84)***	0.0205 (3.05)***	0.0125 (2.22)**	0.0123 (2.22)**
Inflation rate	−0.000560 (−4.76)***	−0.000736 (−5.52)***	−0.000679 (−5.14)***	−0.000600 (−3.81)***	−0.000646 (−4.15)***	−0.000809 (−5.03)***	−0.000635 (−5.15)***	−0.000622 (−5.07)***
Logarithm of neighboring Countries' GDP per capita	0.421 (2.36)**	0.311 (1.64)						
Neighboring Countries' GDP per capita growth rate			−0.00854 (−1.23)					
Logarithm of richer neighboring Countries' GDP per capita				0.452 (1.17)				
Richer neighboring Countries' GDP per capita growth rate					−0.0146 (−2.62)**	−0.00916 (−1.39)		
Logarithm of Richer Countries' GDP per capita							−0.144 (−0.50)	
Richer Countries' GDP per capita growth rate								0.0147 (0.75)
Global RD index		−0.000288 (−2.73)***				−0.000310 (−2.90)***		
Observations	881	879	881	613	613	613	951	951
R^2	0.115	0.134	0.106	0.160	0.163	0.189	0.108	0.109

Year and country fixed effects are included throughout the regressions. Robust *t*-statistics are in parentheses. *p* values are shown with stars (* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$)

GDP figures are in real terms. The global relative deprivation index is the share of world population living in countries with a higher per capita income multiplied by the population weighted mean excess income of this richer part of world population

countries. For instance, one can easily ask if it would be possible to explain China's rapid growth incentive in the absence of countries such as U.S., developed European countries, Japan and so on. To put it even more basically, aren't we simply living in a world where high living standards are set by the richer part of the world and the rest is just trying to catch up with them? The existence of comparison between countries may as well have social consequences which are not less crucial than its economic consequences. For instance, if the citizens of some Middle East and North African countries weren't aware of social standards of developed countries, would we observe the social uprises in those countries at the beginning of the twentyfirst century? One can increase the number of questions related to the social and economic consequences of global comparison groups.

5 Conclusions

The relative deprivation hypothesis assumes that human beings routinely compare themselves to others and this comparison affects their subjective well-being. Our study departs from these studies by forming the comparison groups from outside of a country, the idea which is also used by the new economics of labor migration literature.

Our results show that countries are significantly and negatively affected from the global relative deprivation, measured as an index that is defined as the discrepancy between a country's own income and the average income of the richer countries, multiplied by the share of richer countries' population in the world. We further find that once we control for the effect of RDI, the relationship between per capita income and average life satisfaction in countries disappears both in the time series data and in the cross-sectional data.

Our results for RDI do not generalize to some other simple measures of deprivation, such as the average per capita GDP of the comparison group countries. We explain this by the fact that RDI captures both ranking of countries in terms of their per capita income and the absolute income difference between countries, whereas other simpler measures capture only the latter. This is in line with Clark et al. (2010), which discusses that "*The individual's rank in the income distribution is a stronger determinant of effort than is others' average income, suggesting that comparisons are more ordinal than cardinal.*" Moreover, our empirical results are robust to the inclusion of alternative control variables and panel estimation techniques; however, the existence of comparison groups is valid only for the post-1990 period. This also provides a potential explanation to why an earlier study, Easterlin (1974), finds that rich countries are not necessarily happier than poor ones, whereas more recent studies such as Stevenson and Wolfers (2008), Deaton (2008) find it the other way around.

Even though our results gain significance after the post-1990 period, we are not able to directly associate the feeling of global relative deprivation with the degree of openness of countries, which is measured with political, social and economic openness measures. This may be explained either with the fact that those openness indicators cannot capture the income comparison, or with the fact that in our sample—which is restricted by the availability of the life satisfaction data—countries can already be classified as fairly open countries. That is to say, our sample data allow us to measure the effect of further increases in openness in already fairly open economies; rather than comparing its effects in a closed versus open economy.

Last but not least, our results indicate only an upward comparison within the global comparison groups. The test of downward comparison by using global relative gratification

index yields low level of significance. In other words, when citizens of countries compare themselves to richer countries, they feel deprived but they do not feel better when they compare themselves to poorer countries. Hence, it would not be misleading to conclude that, even though we are now equipped with the most modern tools that make our lives much easier than before, our life satisfaction is mostly determined by what we don't have rather than what we have.

Appendix

Data

The scales are different across the surveys measuring life satisfaction or happiness (such as Word Values Survey, Eurobarometer, Latinobarometro,…); therefore, we use data from World Database of Happiness, which collects data from these sources and converts them to a common (0–10) scale.[27,28] Then, in order to obtain the longest time series data for each country, we use the data source that covers the longest period of time and extend it by using the yearly growth rate of the data from other sources for that country. The idea is that although the levels of the indices may differ across the surveys, changes in these indices should be informative and should reflect changes in overall life satisfaction. Nonetheless, as Table 1 shows, data combining is done only for 8 countries. In cases where the two data sources do not overlap, so that they cannot be combined, the discontinuous data are assessed as two separate countries, which is equivalent to using different fixed effects in the regressions for the two data periods. Thus, the information content of data is not thrown away. Missing values in the data are interpolated. An important exception to interpolation is the data coming from waves of World Values Surveys, which include too many missing observations. Thus, World Values Survey is only used for summary statistics purposes.

Other data sources are as follows. The polity score (polity2) is taken from the Polity IV Project, which rates countries with an index scaling from +10 (strongly democratic) to −10 (strongly autocratic). The project conceives democracy as three essential elements. One is the presence of institutions and procedures through which citizens can express effective preferences about alternative policies and leaders. The second is the existence of institutionalized constraints on the exercise of power by the executive. The third is the guarantee of civil liberties to all citizens in their daily lives and in acts of political participation. The autocracy, on the other hand, defines diverse kinds of political systems whose common properties are a lack of regularized political competition and concern for political freedoms. The globalization index (KOF) is an updated version of Dreher (2006). This index of globalization measures three main dimensions of globalization: economic, social and political. Economic and social dimensions also have sub-dimensions. With regard to the economic globalization index, one of the sub-indices refers to actual economic flows, that use data on trade, foreign direct investment and income payments to

[27] Veenhoven, Ruut. States of Nations, World Database of Happiness, Erasmus University Rotterdam. Available at: www.worlddatabaseofhappiness.eur.nl/statnat.

[28] The rescaling of the data is not a linear one because the distances between different scales are not equal. For instance notice that people who choose 5 on a 0–10 scale have to select 2 or 3 on a 1–4 scale. Therefore, a linear transformation does not necessarily map this data to a correct 0–10 scale, especially with a limited sample size. The method of employed rescaling is explained on the World Database of Happiness website. The basic idea is to use native speakers to read survey questions on happiness and ask them to rescale the answers in the original scale to 0–10 interval.

foreign nationals. Another sub-index of economic globalization index refers to economic restrictions that use data on hidden import barriers, mean tariff rate, taxes on international trade and capital account restrictions. With regard to the social globalization index, the first sub-index refers to personal contact that use data on telephone traffic, transfers, international tourism, foreign population and international letters. The second sub-index refers to information flows that use data on internet users, television and trade in newspapers. The third sub-index regarding the social globalization refers to cultural proximity that use data on number of McDonald's restaurants, number of Ikea and trade in books. Finally, the political globalization index uses data on embassies in country, membership in international organizations, participation in U.N. Security Council Missions and international treaties. The Gini index is taken from the UNU/WIDER's (World Institute for Development Economics Research of the United Nations University) World Income Inequality database (WIID), which is the latest version of Deininger and Squire (1996) dataset. Gini index is measured by different sources and by different methods (e.g. whether it uses income or expenditure, whether it includes urban or rural areas, whether it uses households or individuals, etc.). The WIID brings together the data from these various sources, summarizes them, and also assigns quality indices to each source based on the reliability of the data. Hence, similar to what we have done for the life satisfaction data, we combine the Gini index data coming from various sources by using the yearly growth rates of the data. While deciding which data sources to combine, we use the data sources that (1) are classified as high-quality data (2) are not calculated from a specific geographic part of the country (3) use a variety of *income*, not *consumption or expenditure*, based indices. GDP measures, Population, Inflation Rate, Unemployment Rate, Foreign Trade (% of GDP), the data on International Outbound (Inbound) Tourists and the sum of Public and Private Health Expenditure (% of GDP) are from the World Bank database. Real GDP data are based on a constant 2000 U.S. dollars. PPP adjusted GDP per capita is based on current international dollars.

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